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Deep magmatic processes beneath an active collision zone: Petrological and geochemical evidence from the volcanic plateaus in northeastern Türkiye and western Georgia

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In NE Türkiye, an almost 30,000 km^2 area is covered by young volcanic rocks, ranging in age from Miocene to Quaternary and spanning the whole compositional spectrum from basanites/tephrites to high silica rhyolites. The region exhibits a plateau morphology, known as the Erzurum-Kars Plateau, at ~2 km above sea level. That volcanic plateau continues far beyond the state border into Georgia (ie., the Samtskhe-Javakheti plateaus). Although there are a few studies, the petrological evolution of the these volcanic plateaus is still not well known. To better understand the origin, magmatic history, and geodynamic setting of the volcanism on these plateaus, we, Turkish and Georgian researchers, have been conducting a joint cross-border research project (i.e., TÜBİTAK- SRGNSF project #118Y272) across the region. The volcanic units making up those plateaus are composed of numerous volcanic cones of different shapes and sizes, lava domes, pyroclastic layers, and widespread plateau-forming lavas.

Preliminary findings of our research have revealed that the composition and structure of the lithospheric domains below the plateau might have significant effects on the geochemical character and the lithological features of the volcanics. The volcanic succession covering the Pontide Block in the north is dominated by Late Miocene-Pliocene calc-alkaline andesitic and dacitic lavas, which mostly form medium-sized volcanic edifices. These edifices are partially overlain by Upper Pliocene to Quaternary aged low-viscosity, plateau-forming basic lavas which are also calc-alkaline. Notably, pyroclastics are scarce in the north.

The portion of the plateau that overly the Northeastern Iranian Block and the ophiolitic mélange in the south consists of a much wider variety of lava and pyroclastic lithologies. It starts with a ~5.5 Mys old acid pyroclastic layer at the base, consisting of rhyolitic pyroclastics, domes, and obsidian. It is overlain by the plateau-forming basic to intermediate lavas, Pliocene in age. In turn, the plateau sequence is overlain by a previously unknown caldera-like volcanic complex, which we named “the Digor volcanic complex”, located between Kars and Digor. It has a diameter of ~60 km

and consists of lavas and pyroclastics of Late Pliocene to Quaternary in age, displaying both calcalkaline and alkaline character.

All those volcanics contain a clear inherited subduction signature from previous subduction events (i.e., Pontide Arc in the north). Our petrological melting modellings revealed that the magmas were possibly derived from two contrasting metasomatized lithospheric mantle sources: (1) a spinel peridotite with or without minor amphibole and, (2) a pyroxenitic mafic source with a minor amount of phlogopite. Our data indicate that the melts derived from these two sources were mixed into each other en route to the surface. Most of the plateau lavas might have been derived from the first type (i.e., spinel-peridotite) while the younger alkaline Digor volcanics were dominantly from the second type (i.e., pyroxenite). The thinning of the lithospheric mantle by delamination and the gradual increase of heat coming from the upwelling asthenospheric mantle might be responsible for these variations. Our FC and AFC models show that plateau lavas experienced intense amphibole±garnet fractionation and moderately assimilated continental crust.